

REMARKS

Claims 1-4, 6-18, 20-31, 34-39, 41-44, 50, 52-95, and 97 are pending. Claims 30-38 and 50 are amended. Claims 5, 19, 32, 33, 40, 45049, 51, and 96 are cancelled, without prejudice to the underlying subject matter. Please consider the following remarks.

Claims 30-38 stand rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. This rejection is respectfully traversed. Claims 30-38 are amended to further clarify the recited subject matter. Applicants respectfully request that the 35 U.S.C. § 112, second paragraph, rejection of claims 30-38 be withdrawn.

Claims 16, 29, and 54 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent 6,204,192 ("Zhao et al.") in view of U.S. Patent 5,970,376 ("Chen"). Applicants respectfully traverse this rejection.

Claim 16 defines a method for removing polymer etch residue from an etched opening in a silicon wafer device and recites "contacting said opening with a plasma consisting of oxygen to remove a portion of said etch residue, stopping said oxygen plasma contacting before said polymer etch residue is completely removed and thereafter removing any remaining said residue by contacting said opening with a second plasma, said second plasma consisting of a hydrogen containing gas." This is not taught or suggested by Zhao et al. in view of Chen.

Zhao et al. fails to teach or suggest a method utilizing "contacting said opening with a plasma consisting of oxygen to remove a portion of said etch residue, stopping said oxygen plasma contacting before said polymer etch residue is completely

removed and thereafter removing any remaining said residue by contacting said opening with a second plasma, said second plasma consisting of a hydrogen containing gas." Use of two plasmas, a first containing oxygen and a second containing hydrogen is not taught or suggested anywhere in Zhao et al. Stopping the first oxygen containing plasma use before removal of all residue is not taught or suggested anywhere in Zhao et al. With respect to residue removal, Zhao et al. discloses only a "hydrogen plasma cleaning step" for removal of residues formed by etching of the low k insulation layer (30) to form a via (see FIG. 2 and related description) and the subsequent removal of the resist mask (50) (see FIG. 3 and related description).

The Office Action relies on the doctrine of inherency in attempting to establish that the cited prior art discloses each and every limitation recited by the claim. For a rejection based on the inherency doctrine to be proper, the "Examiner must provide rationale or evidence tending to show inherency," pursuant to M.P.E.P. § 2112. The M.P.E.P. further explains as follows:

The fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic. In re Rijckaert, 9 F.3d 1531, 1534, 28 USPQ2d 1955, 1957 (Fed.Cir. 1993)(reversed rejection because inherency was based on what would result due to optimization of conditions, not what was necessarily present in the prior art); In re Oelrich, 666 F.2d 578, 581-82, 212 USPQ 323, 326 (CCPA 1981). "To establish inherency, the extrinsic evidence 'must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill. Inherency, however, may not be established by probabilities or possibilities. The mere fact that at certain thing may result from a given set of circumstances is not sufficient.'" In re

Robertson, 169 F.3d 743,745, 49 USPQ2d 1949, 1950-51 (Fed.Cir. 1999).

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"In relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art." Ex parte Levy, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990)

M.P.E.P. § 1221 (emphasis and proper citation added).

The Office Action does not meet satisfy the imposed burden to establish that the "ashing step" discussed in the background of Zhao et al. (see col. 1, lines 55-65) inherently provides the limitations of the claim acknowledged as missing from the reference, i.e., removing etch residue with a first oxygen-containing plasma. The "ashing step" is explained in the background to be a photoresist removal procedure (not a residue removal procedure); however, the identical procedure, as disclosed by Zhao et al. as part of the invention, is discussed as creating residues (see col. 4, lines 41-42), not removing residues. Therefore, the reference itself shows that an ashing procedure would not necessarily result in removal of any etch residue (but, instead, may create etch residue) and therefore makes using this portion of its disclosure in an inherency-based argument improper. Additionally, it is clear from the Zhao et al. disclosure that the ashing step is not utilized with the "hydrogen plasma cleaning step," and even if it were, it is not clear that such an ashing step would perform the steps recited by the claim.

Chen provides no teaching or suggestion to supplement the missing disclosure of Zhao et al. so as to render the claimed subject matter obvious. Chen discloses a single plasma step process for removing polymer etch residues, which is not the claimed invention. Nowhere does Chen indicate or suggest that a two plasma process is desirable, useful, or possible.

Since the references, whether or not combined, fail to teach or suggest each limitation of the claim, claim 16 is patentable thereover. Applicants respectfully request that the 35 U.S.C. § 103(a) rejection of claim 16 be withdrawn.

Claim 29 defines a method of forming a contact opening in a semiconductor device and recites, in part, “b) contacting said opening with an oxygen plasma to remove a portion of said etch residue” and “c) removing any remaining etch residue from said etched opening by contacting said opening with a plasma consisting of a hydrogen containing gas in the absence of added oxygen.” Such a method is not taught or suggested by Zhao et al. in view of Chen.

Similar to claim 16, which is discussed above, claim 29 recites a step for removing etch residue with an oxygen plasma and a subsequent step for removing remaining etch residue with a hydrogen-containing plasma in the absence of added oxygen. As discussed above, Zhao et al. fails to teach or suggest, expressly or inherently, use of two etch residue removing plasmas, one containing oxygen and the other containing hydrogen. Additionally, as also discussed above, Chen cannot supplement Zhao et al. in this regard. Therefore, for at least this reason, claim 29 is patentable over these references. Applicants respectfully request that the 35 U.S.C. § 103(a) rejection of claim 29 be withdrawn.

Claim 54 defines a method for removing polymer etch residue from an etched opening in a silicon wafer device and recites, in part, “first contacting said opening with a first plasma to remove a portion of said polymer etch residue” and “stopping said first contacting” and “subsequently contacting said opening with a second plasma to remove the remainder of said polymer etch residue, said first plasma being generated from a gas other than a hydrogen-containing gas and said second plasma being generated from a gas consisting of hydrogen gas.” Since this claim recites two plasma steps for removing etch residue, including a first non-hydrogen-containing plasma and a second hydrogen-containing plasma, it is patentable over Zhao et al. in view of Chen for at least the same reasons as set forth above in relating to the patentability of claim 16. Applicants respectfully request that the 35 U.S.C. § 103(a) rejection of claim 54 be withdrawn.

Claims 1-4, 6-18, 20-31, 34-39, 41-44, and 54-91 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Zhao et al. in view of U.S. Patent 6,277,733 (“Smith”). Applicants respectfully traverse this rejection.

Claim 1 defines a method for removing polymer etch residue from an etched opening in a silicon wafer device and recites, in part, “contacting said opening with a first plasma to remove a portion of said polymer etch residue” and “stopping said contacting with said first plasma before all of said polymer etch residue is removed” and “contacting said opening with a second plasma to remove the polymer etch residue not removed by said first plasma, said second plasma generated from a gas consisting of ammonia and said first plasma being generated from a different gas.” This method is not taught or suggested by Zhao et al. in view of Smith.

Neither Zhao et al. nor Smith teaches or suggests a two plasma process for removal of etch residue. Zhao et al., as explained above in relation to the patentability of claim 16, discloses a single plasma process using a hydrogen plasma. Smith, as discussed in preceding office action response (filed April 14, 2004), does not disclose first and second plasma applications. Since these two references cannot be combined so as to disclose, expressly or inherently, all the features of the claimed method, they would not have rendered the claimed subject matter unpatentable. Applicants respectfully request that the 35 U.S.C. § 103(a) rejection of independent claim 1 and dependent claims 2-4 and 6-15 be withdrawn.

Claims 16, 29 and 54 are discussed above as being patentable over Zhao et al. individually. As explained above, Zhao et al. does not teach a two plasma method for removing etch residue. Smith cannot supplement the Zhao et al. disclosure to provide this teaching. Therefore, as is the case of the combination of Zhao et al. and Chen, claim 16 is patentable over Zhao et al. in view of Smith, too. Applicants respectfully request that the 35 U.S.C. § 103(a) rejection of independent claims 16 and 29 and dependent claims 17, 18, 20-31, 34-39, 41-44, and 54-69 be withdrawn.

Claim 70 defines a method for removing polymer etch residue from an etched opening in a silicon wafer device and recites, in part, "removing said polymer etch residue by contacting it with a first plasma and a second plasma, said first plasma being used to remove only a portion of said residue, said second plasma being used to remove the remainder of said polymer etch residue, said first plasma generated from a gas not containing hydrogen and said second plasma generated from a gas consisting of methane gas." Similar to each claim previously discussed (e.g., claim 16), above, claim 70 recites a two plasma process for removing etch residue and further recites that

the first plasma is a non-hydrogen-generated plasma and the second plasma is a methane-generated plasma. As discussed above, Zhao et al. fails to teach or suggest, expressly or inherently, use of two etch residue removing plasmas. Further, Zhao et al. fails to teach or suggest that the first of the plasmas specifically does not contain hydrogen and the other plasma is generated from methane gas. As with the other claims, Smith cannot supplement Zhao et al. in either regard. Therefore, for at least these reasons, independent claim 70 and dependent claims 71-91 are patentable over these references. Applicants respectfully request that the 35 U.S.C. § 103(a) rejection of claims 70-91 be withdrawn.

Claims 50, 52, 53, 92-95, and 97 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Zhao et al. in view of Smith, further in view of U.S. Patent 6,284,664 ("Kawai"), and further in view of U.S. Patent 6,291,890 ("Hamada"). Applicant respectfully traverses this rejection.

Claim 50 defines a method of forming an integrated circuit structure and recites, in part, "removing polymer residue from said contact opening by first contacting said opening with a first plasma, stopping said first contacting, and subsequently contacting said opening with a second plasma, said first plasma consisting of a gas other than ammonia gas and said second plasma consisting of ammonia gas." Such a method is not taught or suggested by Zhao et al. in view of Smith and in view of Kawai and in view of Hamada.

As already discussed above, neither Zhao et al. nor Smith teaches or suggests a two plasma process for removal of etch residue. Zhao et al., as explained above in relation to the patentability of claim 16, discloses a single plasma process using a

hydrogen plasma. Smith, as discussed in preceding office action responses, does not disclose first and second plasma steps. Neither the Zhao et al. nor the Smith reference teaches or suggests that the second plasma consists of ammonia gas. The disclosures of Kawai and Hamada cannot remedy the inadequacies of Zhao et al. and Smith since both Kawai and Hamada are silent on removing polymer etch residue using plasmas of ammonia, hydrogen, or methane gases. Since these references cannot be combined so as to disclose, expressly or inherently, all the features of the claimed method, they would not have rendered the claimed subject matter unpatentable. Applicants respectfully request that the 35 U.S.C. § 103(a) rejection of independent claim 50 and dependent claims 52 and 53 be withdrawn.

Claim 92 defines a method of forming an integrated circuit structure and recites, in part, "removing polymer residue from said contact opening by first contacting said opening with a first plasma, stopping said first contacting, and second contacting said opening with a second plasma, said first plasma comprising a gas not containing hydrogen gas and said second plasma consisting of hydrogen gas, said removing polymer etch residue providing an oxide free bottom of said contact opening, and which does not substantially increase size of said opening." For at least the same reasoning set forth above relating to the patentability of claim 50, claim 92 is likewise patentable. Applicants respectfully request that the 35 U.S.C. § 103(a) rejection of claims 92-94 be withdrawn.

Claim 95 defines a method of forming an integrated circuit structure and recites, in part, "removing polymer residue from said contact opening by first contacting said opening with an oxygen plasma, stopping said first contacting, and second contacting said opening with a methane-comprising plasma, said removing

providing an oxide free bottom of said contact opening and without substantially increasing the size of said opening." For at least the same reasoning set forth above relating to the patentability of claim 50, claim 95 is likewise patentable. Applicants respectfully request that the 35 U.S.C. § 103(a) rejection of claims 95 and 97 be withdrawn.

In view of the above amendment, Applicants believe the pending application is in condition for allowance. Applicants respectfully request that a Notice of Allowance be immediately mailed.

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Respectfully submitted,

By 

Thomas J. D'Amico

Registration No.: 28,371

Ryan H. Flax

Registration No.: 48,141

DICKSTEIN SHAPIRO MORIN &

OSHINSKY LLP

2101 L Street NW

Washington, DC 20037-1526

(202) 785-9700

Attorney for Applicants